

**GREEN PRODUCT INNOVATION:  
WHERE WE ARE AND WHERE WE ARE GOING**

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**Abstract**

Green product innovation (GPI) is getting more and more relevant for policy makers, companies, and society as a whole. As a result, over the last few years the number of studies on GPI development has increased substantially, thus prompting the need to analyse and synthesize the results of these studies. To this aim, this study reviews the body of knowledge on the topic. In particular, a systematic review of the literature is conducted, guided by three main research questions. Specifically, this paper identifies the antecedents, the outcomes, and the success factors of GPI development. 63 studies are included in the review. Results show that many factors drive the development of GPI, both internal and external to the firm. Among internal factors, the most important are the prospect of competitive advantage, costs reduction, and market benefits, improved reputation, and opportunities for innovation. Among external factors, the most important are environmental regulations – current and/or expected – and market demand. In terms of outcomes, this study puts in evidence that the most relevant ones are cost savings, achievement of competitive advantage, increased market share, increased sales, increased turnover, higher profits, better reputation, increased exports, and higher productivity. Finally, this study highlights that many factors can influence the successful development of GPI, such as top management commitment, building networks of collaborations as well as enhancing knowledge flows, both within and outside the firm, cross-functional integration, and development of resources and capabilities. This study provides important implications for companies, policy makers, and scholars.

**Keywords:** green product; green innovation; systematic review; sustainable development

## **1. INTRODUCTION**

Since the United Nations Conference on the Human Environment, held in Stockholm in 1972, global environmental problems have been discussed at policy level and environmental sustainability have entered the political agenda of most countries. Within this context, companies can play a key role. One way through which companies can contribute to the achievement of environmental sustainability objectives is the development of green products. Green products, defined as products that “use less resources, have lower impacts and risks to the environment and prevent waste generation already at the conception stage” (Commission of the European Communities, 2001 ; p. 3), have been recognized as the engine of a “new growth paradigm and a higher quality of life through wealth creation and competitiveness” (Commission of the European Communities, 2001 ; p. 3).

Despite the fact that environmental issues had been relegated to minor roles in the innovation research agenda for many years, sustainability has by now been acknowledged as a key driver of innovation (Nidumolu *et al.*, 2009) and green product innovation (GPI) research has rapidly grown over the last few years.

This prompts the need to analyse and synthesize results of the many studies that have been conducted over the years. A first important work in this direction is that by Baumann *et al.* (2002), who reviewed 650 articles (ranging from 1970 to 1999) dealing with green product development from three different disciplines, namely engineering, management, and policy studies. More recently, Pereira and Vence (2012) conducted a review of the literature on the determinants of eco-innovation (without a specific focus on product innovation), analysing 14 studies from 2006 to 2011. Adams *et al.* (2012), on behalf of the Network for Business Sustainability, conducted a broad systematic review on the so called sustainability-oriented innovation, analysing 100 articles from 1992 to 2012. However, their effort was directed towards innovation in general without a specific focus on product innovation. de Medeiros *et al.* (2014) conducted a systematic review of the literature, within 32 selected journals, and analysed 67 studies to identify factors and variables driving market success of environmentally sustainable product innovation. However, the combinations of keywords used appear to be limited, leaving outside the search domain important keywords, such as “green product”, “green product innovation”, or “eco-innovation”.

Despite these relevant attempts to analyse and synthesize past studies on green innovation, up-to-dated and complete review studies, with a specific focus on green product innovation, simultaneously addressing antecedents, outcomes, and success factors of GPI development

are missing so far. The aim of the paper is to provide a complete picture of the research that has been conducted on GPI, to provide future research directions on the topic, and to encourage GPI development by giving clear suggestions to policy makers and to companies in terms of their innovation strategies.

To this aim, a systematic review of the relevant body of knowledge on GPI will be conducted, guided by three main research questions:

- RQ1: Which are the antecedents of GPI development?
- RQ2: Which are the outcomes of GPI development?
- RQ3: Which are the success factors of GPI development?

The focus will be on empirical studies dealing with manufacturing industries, published in scientific peer-reviewed journals, in English, adopting a managerial/organizational perspective (with a focus within the company). No time limits were established. Upper limit was determined by the time when the search was performed, i.e. May 2013.

In Figure 1, the theoretical framework of this study is represented. In particular, the central box represents GPI development, with the left arrow representing the antecedents (inputs) of it, the right arrow the outcomes (outputs) and, finally, the below arrow the success factors. Each arrow thus represents one of the three research questions.

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Further analyses have been conducted on reviewed studies, with specific regard to the theories adopted, the methodologies used, and the countries where the studies have been conducted.

The paper is structured as follows. In the next section, methodological details are provided. Then, results are presented in terms of characteristics of studies included in the systematic review. After that, results related to the research questions are reported and then analysed through the resource-based view lens. Finally, implications and future research directions are provided.

## **2. METHODOLOGY**

This study uses the systematic review methodology. A systematic review tries to collect all empirical evidence fitting previously identified eligibility criteria, with the aim to answer

specific research questions. Systematic methods are used to collect and analyse data to provide reliable results (Higgins and Green, 2011).

### **2.1. Data collection**

Studies to be included in the review were identified by searching the following databases: Ebsco, Scopus, and Web of knowledge. Descriptions of these databases and of search options are provided in table 1.

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All databases were searched using combinations of selected keywords. In table 2, keywords' combinations are reported along rows while databases are reported in the columns. Thus, in each table cell there is the number of results obtained for each keywords' combination within each database. In the last row, the total numbers of retrieved papers in each database and across databases are reported.

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### **2.2. Study selection**

The study selection process took place through several steps. First, all duplicate articles, within and across databases, were discarded. Then, the titles and abstracts of the retrieved articles were reviewed for a first analysis of their relevance to the research questions and the non-relevant articles were excluded. After this process, 138 potentially relevant articles were retained and included in the full-text search. For 8 of them full-text was not available. For the other ones the full text was reviewed for an in-depth analysis of relevance. 72 of the reviewed studies were evaluated as non-relevant after the full-text analysis, so leading to retain 58 relevant studies. Further, the bibliography of these studies was analysed to check for other articles potentially relevant to the research questions and this led to the identification of four relevant articles. At the end of the process, 63 articles were included in the systematic review.

During the selection process, non-relevant articles were identified as follows. First of all, all studies in which the searched terms had a meaning different from the intended one (e.g., many chemistry studies use the term “green product” to mean a product with a green colour) were discarded. Then, articles that did not adopt a managerial/organizational perspective (with a focus within the company) were discarded. Thus, studies focusing only on regulatory issues, such as studies dealing with the effect of the introduction of specific policies, taxes, and regulations on green product innovation, or adopting a consumer behaviour/marketing perspective, were excluded. Also articles dealing with specific technologies, methods or tools (such as life cycle assessment), eco-design, sustainability or corporate social responsibility in general, or exclusively focusing on supply chain management were discarded. Further, studies without an empirical basis were excluded. Finally, due to the review focus on green innovation in manufacturing industries, studies conducted within services sectors, such as green hotels or green banking, were discarded.

### **2.3. Data extraction**

For each study, data from the full text were extracted. These data included author(s), publication name, year of publication, title, type of study (qualitative, quantitative, or hybrid), data collection methodology (for quantitative studies), case study methodology type – single vs. multiple (for qualitative studies), sample size, country/countries where the study was conducted, adopted theory, this study’s research question(s) that have been addressed, and main results relating to this study’s research question(s).

## **3. ANALYSIS OF RESULTS**

### **3.1. Selected studies’ characteristics**

Table 3 reports the names of the publications where the reviewed studies have been published. The journal where most studies included in the review have been published is *Business Strategy and the Environment*, followed by *Journal of Cleaner Production*, *Ecological Economics*, and *Journal of Business Ethics*.

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Figure 2 depicts the evolution of the number of studies over time. The first study included in the review dates back to 1991. Since then, there has been a fluctuating, but overall growing, trend of the number of studies published each year, with a quite rapid increase over the past eight years.

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Figure 3 reports the partitioning of studies based on study type, distinguished into qualitative, quantitative, or hybrid (employing both qualitative and quantitative methods). 32 studies (corresponding to 51%) are quantitative in nature, 28 (corresponding to 44%) are qualitative, whereas three (corresponding to 5%) are hybrid.

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In terms of data collection methodology in quantitative studies, 30 studies (corresponding to 94%) used surveys, whereas two of them (corresponding to 6%) used content analysis of company reports. With regard to sample size in quantitative studies, the smallest one is 68, whereas the largest one is 5476.

Most qualitative studies (18, corresponding to 64%) adopted a multiple case study methodology (with a number of cases quite variable, with a maximum of 26 cases), whereas ten of them (corresponding to 36%) adopted a single case study methodology. .

With regard to countries where studies have been conducted, as shown in figure 4, most studies (51, corresponding to 81%) were conducted in a single country, seven studies (corresponding to 11%) were conducted in two countries, whereas five studies (corresponding to 8%) were conducted in three or more countries.

As shown in figure 5, eight of the multi-country studies, (corresponding to 13% of the total number of studies) were conducted in countries belonging to the same continent, whereas four of them (corresponding to 6% of the total number of studies) were conducted in countries belonging to different continents.

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Table 4 reports the countries where the reviewed studies have been conducted<sup>1</sup>. As a general result, most studies have been conducted in European countries and the top three most represented countries are Germany, UK, and the Netherlands. Further, there is a scant presence of studies in developing countries.

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### **3.2. Objectives of the studies**

With regard to the objectives of the studies included in the review, their relevance to this study's research questions was analysed. Table 5 shows that the most addressed research question is that related to antecedents of GPI (with 38 studies addressing it), followed by success factors of GPI (with 33 studies addressing it) and outcomes of GPI (with 18 studies addressing it).

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With regard to the number of this study's research questions addressed, table 6 shows that most studies (40) address just one research question, whereas 20 simultaneously address two research questions, and only three studies simultaneously address the three research questions.

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<sup>1</sup> In this analysis, two studies (Albino et al., 2009; Albino et al., 2012) have not been included, since they refer to companies' geographical area without specifying countries.

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### **3.3. Theories used**

With regard to theories adopted, few studies explicitly rely on established organizational and managerial theories, such as the stakeholders theory (Guoyou *et al.*, 2013; Huang *et al.*, 2009; Polonsky and Ottman, 1998), the resource-based view (RBV) (Kammerer, 2009; Ziegler and Seijas Nogareda, 2009), the entrepreneurship theory (Larson, 2000; Stafford *et al.*, 2000), the innovation theory (e.g., Horbach, 2008; Ray and Ray, 2010; Rennings and Rammer, 2009), and the social network theory (Conway and Steward, 1998). Most studies refer to literature streams that could be general, such as new product development (e.g., Driessen *et al.*, 2013; Kivimaa, 2008; Magnusson and Berggren, 2001), R&D (Foster and Green, 2000; Noci and Verganti, 1999), supply chain management (de Carvalho and Barbieri, 2012; Lee and Kim, 2011; 2012) or specific to the environmental context, such as corporate environmental management (e.g., Chang, 2011; Chen, 2008), corporate sustainability (e.g., Bos-Brouwers, 2010), green product development (e.g., Dangelico and Pujari, 2010), and green marketing (Langerak *et al.*, 1998; Leonidou *et al.*, 2013).

### **3.4. Antecedents of GPI**

Antecedents of GPI can be distinguished into antecedents internal to the firm, which also include firm characteristics, and antecedents external to the firm.

#### Internal

Among internal antecedents, there are the prospect of competitive advantage (Lee and Kim, 2011; Liu *et al.*, 2011; Pujari and Wright, 1999; Tötzer and Ömer-Rieder, 2007; Triebswetter and Wackerbauer, 2008a), cost reduction (for example, through energy savings) (Horbach *et al.*, 2012; Keskin *et al.*, 2013; Liu *et al.*, 2011; Tötzer and Ömer-Rieder, 2007; Triebswetter and Wackerbauer, 2008b), market benefits (such as potential market opportunities, opening of new markets, increase of market share) (Dangelico and Pujari, 2010; Green *et al.*, 1994; Keskin *et al.*, 2013; Pujari and Wright, 1999; Rennings *et al.*, 2006; Triebswetter and Wackerbauer, 2008a; van Hemel and Cramer, 2002), and profits (Dangelico and Pujari, 2010). Important antecedents of GPI development are also the expectation of improvement of corporate reputation and image (Dangelico and Pujari, 2010; Pujari and Wright, 1999;



Rennings *et al.*, 2006) as well as opportunities to create innovations and increase the quality of products (Keskin *et al.*, 2013; Rennings *et al.*, 2006; van Hemel and Cramer, 2002).

Other internal antecedents are linked to values and culture, such as entrepreneurs' personal values, ecological responsibility (deriving from company concerns for social obligations and values), corporate environmental ethics and culture (Chang, 2011; Chen *et al.*, 2012; Dangelico and Pujari, 2010; Keskin *et al.*, 2013; Pujari and Wright, 1999). The existence of specific policies and strategies also drives GPI development. These include green company policies (in terms of level of commitment that a firm demonstrates to initiatives limiting its environmental impact), environmental product policies (in terms of corporate environmental policies explicitly addressing environmental issues in new product development decisions), and environmental strategic approaches (such as, green management, material eco-efficiency, energy efficiency, and supply chain management) (Albino *et al.*, 2009; Albino *et al.*, 2012; Driessen *et al.*, 2013; Green *et al.*, 1994; Pujari *et al.*, 2004).

Further, pressures exerted by internal stakeholders (such as top management, shareholders, managers, and employees) (Blomquist and Sandström, 2004; Chen *et al.*, 2012; Green *et al.*, 1994; Huang *et al.*, 2009; Pujari *et al.*, 2004; Pujari and Wright, 1999) also positively impact on GPI development.

Green capabilities (in terms of "a firm's abilities to integrate, coordinate, build, and reconfigure its competences and resources to accomplish environmental management and environmental innovations" (Chen *et al.*, 2012, p. 375), technological capabilities (in terms of R&D activities and high qualification of employees), and green design activities (Horbach, 2008; Kammerer, 2009; Rehfeld *et al.*, 2007; Tsai *et al.*, 2012) are also important antecedents of GPI. Other antecedents are environmental leadership (conceived as the process through which an individual involves other people into the achievement of environmental goals (Chen *et al.*, 2012)) and search for technological lead (Triebswetter and Wackerbauer, 2008b).

Other factors stimulating GPI are uncertainty avoidance and risk aversion (Leonidou *et al.*, 2013; Wagner, 2009) as well as marketing orientation, eco-labelling activities, informing consumers about the environmental quality of products, conducting market research (Tsai *et al.*, 2012; Wagner, 2008; 2009), and scrutinizing customers and competitors (Driessen *et al.*, 2013).

Finally, creating environmental awareness (Keskin *et al.*, 2013) and establishing a long-term, strategic partnership with a focal company or a buying company in the supply chain (Lee and Kim, 2011) favour the development of GPI.

Some studies also highlight the influence of firm characteristics on GPI. The existence of slack resources positively affects GPI development (Leonidou *et al.*, 2013). With regard to the influence of the existence of an environmental management system (EMS) within the company, there are contrasting results. Some studies highlight that the existence of an EMS (Leenders and Chandra, 2013; Rehfeld *et al.*, 2007), environmental management tools (Horbach, 2008), and the learning processes activated by the EMS (Rennings *et al.*, 2006) positively impact on GPI development, whereas other studies find that EMS is not significant (Rennings *et al.*, 2006; Wagner, 2008; 2009). There are contrasting results also with regard to firm international characteristics and size. Cainelli *et al.* (2011) highlight that foreign ownership has a positive influence on GPI, whereas Guoyou *et al.* (2013) find that foreign ownership has a significant effect only on process innovation. Leonidou *et al.* (2013) and Rehfeld *et al.* (2007) highlight that firm size has a positive impact on GPI, whereas Wagner (2007 ; 2008 ; 2009) and Horbach (2008) find that firm size is not significant.

#### External

With regard to antecedents external to the firm, the most mentioned one is represented by environmental regulations and policies – current and/or expected (Blomquist and Sandström, 2004; Chen *et al.*, 2012; Conway and Steward, 1998; Dangelico and Pujari, 2010; Foster and Green, 2000; Green *et al.*, 1994; Horbach *et al.*, 2012; Huang *et al.*, 2009; Kammerer, 2009; Kivimaa, 2007; Langerak *et al.*, 1998; Lee and Kim, 2011; Leenders and Chandra, 2013; Liu *et al.*, 2011; Noci and Verganti, 1999; Pujari and Wright, 1999; Rehfeld *et al.*, 2007; Tötzer and Ömer-Rieder, 2007; Triebswetter and Wackerbauer, 2008a; van Hemel and Cramer, 2002; Visser *et al.*, 2008), followed by market demand and market stakeholders' pressures (Chen *et al.*, 2012; Conway and Steward, 1998; Foster and Green, 2000; Green *et al.*, 1994; Horbach *et al.*, 2012; Huang *et al.*, 2009; Kivimaa, 2007; Langerak *et al.*, 1998; Lin *et al.*, 2013; Liu *et al.*, 2011; Pujari and Wright, 1999; Triebswetter and Wackerbauer, 2008a; Tsai *et al.*, 2012; van Hemel and Cramer, 2002; Visser *et al.*, 2008).

Other external drivers are technological developments deriving from R&D activities conducted outside the company (Conway and Steward, 1998; Kivimaa, 2007) as well as the political and cultural environment (in terms of environmental awareness and concern of public bodies, government, and the general public) (Conway and Steward, 1998; Noci and Verganti, 1999), and media attention for the environmental impact of company activities (Pujari and Wright, 1999; Visser *et al.*, 2008). A contrasting result is that obtained by Guoyou

*et al.* (2013), finding that community and regulatory stakeholders' pressures have no effect on GPI.

Further, even networking activities positively influence GPI development. In particular, these are discussions in professional networks, industrial sector initiatives (van Hemel and Cramer, 2002; Visser *et al.*, 2008), cooperation with environmentally concerned stakeholders (Cainelli *et al.*, 2011), and networking with other firms and institutions (Wagner, 2007).

Finally, competitive intensity and rival green products appearing (Conway and Steward, 1998; Green *et al.*, 1994; Langerak *et al.*, 1998) as well as customers' pressures (Guoyou *et al.*, 2013; Pujari and Wright, 1999) and the potential for customer benefit (Kammerer, 2009) also stimulate GPI.

### **3.5. Outcomes of GPI**

Market, economic, and financial outcomes are the most mentioned outcomes of GPI development. These include cost savings (Langerak *et al.*, 1998; Liu *et al.*, 2011; Rennings and Rammer, 2009; 2011; Triebswetter and Wackerbauer, 2008a; Triebswetter and Wackerbauer, 2008b), achievement of competitive advantage (Chang, 2011; Chen *et al.*, 2006; Triebswetter and Wackerbauer, 2008a; Triebswetter and Wackerbauer, 2008b), increased market share (Leonidou *et al.*, 2013; Lin *et al.*, 2013; Liu *et al.*, 2011; Triebswetter and Wackerbauer, 2008a; Triebswetter and Wackerbauer, 2008b), increased sales (Leenders and Chandra, 2013; Leonidou *et al.*, 2013; Lin *et al.*, 2013; Liu *et al.*, 2011), increased turnover (Horbach *et al.*, 2012; Langerak *et al.*, 1998; Triebswetter and Wackerbauer, 2008a; Triebswetter and Wackerbauer, 2008b), higher profits (Cainelli *et al.*, 2011; Leenders and Chandra, 2013; Lin *et al.*, 2013), higher ROI (Leenders and Chandra, 2013), and better reputation (Chen, 2008; Driessen *et al.*, 2013; Lin *et al.*, 2013).

Other outcomes include increased exports (Liu *et al.*, 2011; Triebswetter and Wackerbauer, 2008a; Triebswetter and Wackerbauer, 2008b) and higher productivity (Cainelli *et al.*, 2011; Leenders and Chandra, 2013; Rennings and Rammer, 2009; 2011). Contrasting results are those by Driessen *et al.* (2013), finding that GPI is associated with low financial performance, and those by Liu *et al.* (2011), highlighting that integrated environmental innovations (process innovation and product innovation) lead to an increase in costs. Further, Driessen *et al.* (2013) find that GPI is associated with low customer performance, in terms of sales and market share.

Despite partially included into broader market performance, in terms of sales and market share, customers outcomes of GPI development are highlighted to be relevant in the literature. This dimension of performance includes the acquisition of new customers (Liu *et al.*, 2011; Triebswetter and Wackerbauer, 2008a; Triebswetter and Wackerbauer, 2008b), better customer satisfaction (Leonidou *et al.*, 2013), and increased willingness to pay a premium price (Langerak *et al.*, 1998).

Another category of outcomes refers to innovation performance. This includes the development of patents (Liu *et al.*, 2011; Triebswetter and Wackerbauer, 2008a; Triebswetter and Wackerbauer, 2008b), the development of new products (Rennings and Rammer, 2009; 2011), and better product quality (Wong, 2012).

Finally, other outcomes are Eco-Management and Audit Scheme (EMAS) certification (Ziegler and Seijas Nogareda, 2009), employment growth, higher skill level of employees, and long term employment (Cainelli *et al.*, 2011; Liu *et al.*, 2011; Triebswetter and Wackerbauer, 2008a; Triebswetter and Wackerbauer, 2008b).

### **3.6. Success factors of GPI**

First, adapting the classification proposed by Sandström and Tingström (2008), success factors of GPI are divided into factors relating to management, relationships, resources and capabilities, and development process. Then, the results are analysed through the RBV lens.

#### **3.6.1. Management**

With regard to the management category, the literature highlights that top management and company commitment (Conway and Steward, 1998; Curwen *et al.*, 2013; Huang and Wu, 2010; Pujari *et al.*, 2003; Sandström and Tingström, 2008), considering environmental aspects from the start, and having environmental champions (Sandström and Tingström, 2008) are key success factors of GPI development. Further, having teams that coordinate the environmental management within the company (Pujari and Wright, 1996), formalizing environmental policies and targets for products (Dangelico and Pujari, 2010; Pujari and Wright, 1996) and widening the focus of a GPI strategy to the whole organization (Blomquist and Sandström, 2004) also represent important success factors.

#### **3.6.2. Relationships**

Differently from what proposed by Sandström and Tingström (2008), the category “consumer relationship” has been enlarged to include any type of relationship. On turn, relationships

have been distinguished into collaborations and knowledge flows (according to what proposed by Dangelico *et al.*, 2013)<sup>2</sup>.

#### Collaborations

Collaborations with different types of actors have been identified as success factors of GPI. These include collaborations with suppliers (Bos-Brouwers, 2010; de Carvalho and Barbieri, 2012; Green *et al.*, 1994; Lee and Kim, 2011; Pujari, 2006; Pujari *et al.*, 2003; Rennings and Rammer, 2009; Roy and Whelan, 1992; Sandström and Tingström, 2008), collaborations with customers (Bos-Brouwers, 2010; Green *et al.*, 1994; Rennings and Rammer, 2009; Roy and Whelan, 1992; Sandström and Tingström, 2008), collaborations with environmental groups and NGOs (Glasbergen and Groenenberg, 2001; Stafford *et al.*, 2000; Westley and Vredenburg, 1991), collaborations with knowledge institutions and local government (Bos-Brouwers, 2010), collaborations within company's own enterprise group (Rennings and Rammer, 2009), and collaborations with business partners and research partners (Tötzer and Ömer-Rieder, 2007). Finally, cultivation and leadership of a network of players (Larson, 2000), external validation of the opportunity (i.e. presenting product ideas to a professional audience for feedback), and network orientation (Keskin *et al.*, 2013) have been highlighted as success factors.

#### Knowledge flows

Knowledge flows from and towards external actors have been identified as success factors of GPI development. In particular, these include extensive communication between the firm and its stakeholders (customers, suppliers, employees, stockholders, special interest groups, and top management) (Polonsky and Ottman, 1998), search for innovation impulses from a variety of knowledge sources (Dangelico and Pujari, 2010; Rennings and Rammer, 2009), exploitation of the local knowledge base and creation of local innovation clusters (Ray and Ray, 2010), creation of knowledge networks (Noci and Verganti, 1999), and educating users (in terms of passing them environmental information) (Foster and Green, 2000).

### **3.6.3. Development process**

There is a well-grounded amount of literature that looks at new product development as a process, analyses its different steps, and identifies its success factors (e.g., Cooper and Kleinschmidt, 1986; Cooper and Kleinschmidt, 1987; Cooper and Kleinschmidt, 1995).

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<sup>2</sup> Despite relevant to this review, the study of Dangelico *et al.* (2013) has not been included since at the time of data collection it had not yet been published.

Adopting this perspective, several of the reviewed studies identify the characteristics of the development process that are key for a successful GPI development. The most mentioned one in the literature relates to putting in place of cross-functional teams, cross-functional integration and coordination (Conway and Steward, 1998; Curwen *et al.*, 2013; Huang and Wu, 2010; Kivimaa, 2008; Pujari, 2006; Pujari *et al.*, 2003; Sandström and Tingström, 2008), followed by the implementation of eco-design and life cycle assessment practices (Dangelico and Pujari, 2010; Kivimaa, 2008; Pujari, 2006; Pujari *et al.*, 2003; Sandström and Tingström, 2008). Other important characteristics of the development process are intense communication and knowledge flows, both within the company and with external actors (Curwen *et al.*, 2013; Dangelico and Pujari, 2010; Magnusson and Berggren, 2001), market focus/orientation (in particular, establishing specific target market for greener products and assessing market needs) (Keskin *et al.*, 2013; Pujari, 2006), effective groundwork (in terms of screening of product ideas, project definition, and business analysis) (Pujari *et al.*, 2003), up-front testing (Magnusson and Berggren, 2001), and providing positive feedbacks and encouragement to employees by management (Sandström and Tingström, 2008; Verhulst, 2012). Further issues emerged as relevant are: setting clear environmental targets, criteria, and practices (Kivimaa, 2008; Magnusson and Berggren, 2001; Sandström and Tingström, 2008), conducting environmental benchmarking (Huang and Wu, 2010; Pujari *et al.*, 2003), and involving individuals directly in the development project (Conway and Steward, 1998).

#### **3.6.4. Resources and capabilities**

Differently from what proposed by Sandström and Tingström (2008), the category “competence” has been enlarged and named “resources and capabilities”. According to the RBV, firms can be conceived as a combination of resources. Resources can be defined as “stocks of available factors that are owned or controlled by the firm” whereas capabilities refer to “a firm’s capacity to deploy resources usually in combination, using organizational processes, to effect a desired end” (Amit and Schoemaker, 1993 p. 35). When resources are valuable, rare, imperfectly imitable, and non-substitutable, they can be a source of sustained competitive advantage (Barney, 1991). Thus, managers’ challenge is to identify, enhance, protect, and exploit key resources and capabilities (Amit and Schoemaker, 1993).

This study’s results identified key firm resources and capabilities for the success of GPI. These include internal R&D (in terms of increased investments and reorganization of aims) (Green *et al.*, 1994; Horbach *et al.*, 2012; Huang and Wu, 2010; Rennings and Rammer, 2009), human resources (in terms of education and training of personnel as well as presence

of environmental specialists) (Keskin *et al.*, 2013; Kivimaa, 2008; Sandström and Tingström, 2008), innovative capacity of the firm, and innovation management skills (Driessen *et al.*, 2013; Horbach *et al.*, 2012; Keskin *et al.*, 2013).

Other success factors in this category include the capability to develop new materials/components (Green *et al.*, 1994), green core competencies (in terms of environmental capabilities, technologies, or know-how that are valuable, rare, imperfectly imitable, and non-substitutable) (Chen, 2008), the presence of intelligence systems (to scan for opportunities and threats, key competencies, and key technologies) (Noci and Verganti, 1999), and a company green image, a key resource for firms (Noci and Verganti, 1999).

### ***3.6.5. Analysis of results through the RBV theoretical lens***

Even though most authors of the reviewed studies do not rely on established organizational and managerial theories, the results on the success factors of GPI development, beside those explicitly included in the sub-group “resources and capabilities”, can be explained through the theoretical lens of the RBV.

Looking at the new product development process, Verona (1999) identified four categories of capabilities relevant for new product development: technological, external integrative, internal integrative, and marketing capabilities.

In the following, I will analyse the identified success factors of GPI development in terms of capabilities, classifying them along these four categories. A synthesis of this analysis is reported in figure 6.

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*Technological capabilities* include firm’s scientific expertise (R&D), manufacturing routines, design, and technological complementarities (Verona, 1999). In the GPI development domain, these capabilities include the environmental R&D capability (the capability to develop and manage environmental technologies), the innovation capability (e.g., the capability to develop new materials with reduced environmental impact), the capability to scan for key green competencies and technologies, and the capability to conduct eco-design and life cycle assessment studies.

*External integrative capabilities* allow the firm to absorb knowledge from external sources (Verona, 1999). As emerged from the review, in the GPI domain, these capabilities include the capability to establish and manage intense communication and knowledge flows with a variety of external actors and the capability to establish and manage collaborations with a variety of external actors. As for conventional new product development, external actors include customers, suppliers, employees, stockholders, special interest groups, research institutions, and local government. Additional external actors relevant for GPI development are environmental NGOs. Another capability to be included into this category is the capability for effective recruitment of people with environmental skills and expertise.

*Internal integrative capabilities* allow the firm to organize the use of produced and absorbed technological and marketing knowledge (Verona, 1999). Similarly to what happens for conventional new product development, this category includes the capability to foster cross-functional integration, coordination, and knowledge flows among product development team members and among different functional areas of the firm. However, in the GPI development domain, team members should include environmental specialists and the integration of other functional areas with those devoted to environmental issues (such as environmental affairs or environment, health, and safety departments) emerged to be particularly relevant. Further, this category includes the capability to provide effective environmental education and training as well as to provide positive feedbacks and encouragement to employees. Another key capability is the development of a corporate culture that encourages environmental commitment throughout the company. This result can be achieved through different means, including setting clear environmental targets, criteria, and practices.

*Marketing capabilities* refer to the screening, use, and dissemination of market information (Verona, 1999). In the GPI development domain, this category includes market focus/orientation (in particular, the capability to establish specific target market for green products and assessing market needs), the capability to develop and manage a good company green image, and the capability to scan for opportunities and threats offered by the green market. This category also includes the capability to conduct environmental benchmarking.

This analysis highlights the success factors of GPI development in terms of capabilities. Even though many of them are in common with conventional new product development, it emerges that some distinctive capabilities are required for successful GPI development, such as the capability to conduct eco-design and life cycle assessment studies, the development of a



company culture that fosters environmental commitment, and knowledge exchange and collaboration with environmental NGOs.

#### **4. IMPLICATIONS AND FUTURE RESEARCH DIRECTIONS**

This study provides in-depth analysis and synthesis of the body of knowledge so far produced in the field of GPI. As such, it has important implications for companies, for policy makers, and for scholars as well.

With regard to companies aiming at successfully developing GPI, this study highlights what drives a company to develop green products, which outcomes should a company expect from developing them, and which are the success factors of such a development, so providing useful directions for their innovation strategies.

In terms of antecedents, this study highlights that there are many factors driving the development of GPI, both internal and external to the firm. Among internal factors, the most important are the prospect of competitive advantage, costs reduction, and market benefits, the expectation of improvement of reputation and of opportunities for innovation as well. Thus, top management should be kept informed about the potential benefits of developing GPI and create commitment to develop GPI throughout the company.

Among external factors, the most important are environmental regulations – current and/or expected – followed by market demand and market stakeholders pressure. A little less relevant seems to be technology. Networking activities also proved to positively influence GPI development. The key role of environmental regulations as antecedent of GPI should make companies see them as an opportunity to innovate rather than as a constraint. In particular, environmental regulations represent an incentive for firms to make their product offerings greener and greener. This can result in the development of incremental innovations and/or of radical innovations whose greenness may go far beyond that fixed by regulations. Current or expected environmental regulations may also represent an opportunity for new businesses to be created. Market demand and market stakeholders pressure, on the other hand, also exert an important influence on GPI development. This means that companies should put much attention to hear the market voice in order to set their innovation strategies. Many means are available today for that: more conventional means coexist with new ones, such as social media that allow companies to be very close to customers' opinions, needs, and wishes. In terms of outcomes, this study puts in evidence that the most relevant ones are cost savings,

achievement of competitive advantage, increased market share, increased sales, increased turnover, higher profits, better reputation, increased exports, and higher productivity. These results highlight that being “green and competitive” (Porter and van der Linde, 1995) is actually possible and top management should be aware of the opportunities provided by GPI development and make GPI a key component of the company innovation strategy.

Finally, this study highlights that many factors can influence the successful development of GPI. Among managerial factors, top management commitment is key, as well as considering environmental aspects from the start, having environmental champions, and formalizing environmental policies and targets for products. Thus, managerial efforts should be directed towards these activities. Further, this study puts in evidence that creating and fostering networks of collaborations as well as enhancing knowledge exchange, both within and outside the firm is beneficial for GPI development. In terms of development process, cross-functional teams, integration, and coordination as well as implementing eco-design and life cycle assessment are the most important success factors. Thus, companies willing to successfully develop green products should make networking activities, both outside and within the firm, a key aspect of their innovation strategy, ensure a suitable level of integration and coordination among different functional areas, and put in place useful tools for eco-design. Resource and capabilities also proved to be key factors of a successful GPI development. Thus, firms should invest in building and fostering their green capabilities as well as adequately train employees on environmental issues so as to strengthen their human resources.

This study also provides useful implications for policy makers. In fact, it highlights that environmental regulations represent the most important external driver for GPI development. Thus, public policies should be devoted to issue stricter and stricter environmental regulations and/or to enlarge the number of industries to which they apply so as to encourage greener innovations across all industries.

Regarding implications for scholars, since this study deeply analyses “where we are” in terms of research on GPI development, providing a picture of the state of the art, it can be a useful starting point for future research in the field, that is “where we are going”. In particular, with regard to each research question, there are issues needing to be deepened, linked to contrasting results.

Referring to GPI antecedents, there are contrasting results related to the influence of foreign ownership, firm size, EMS, community and regulatory stakeholders. It would be interesting deepening our knowledge on the conditions under which there are significant and positive

influences of these factors. Further, it would be useful simultaneously considering different antecedents to understand their relative influence on GPI development.

With regard to GPI outcomes contrasting results relate to financial and market performance. It would be interesting to deepen our knowledge on these issues and understand under what conditions GPI development leads to high financial and market performance and whether the results vary across industries.

Referring to success factors of GPI, future research should be more explicit in distinguishing between environmental performance and market/financial performance of GPI or between incremental GPI and radical GPI.

Future studies should also be devoted to broaden research on GPI to other countries, especially developing ones, where limited research on GPI has been conducted so far. This could be useful to understand whether antecedents, outcomes, and success factors are different from those found for developed countries. Further, multi-country and multi-continent studies should be encouraged to identify differences among countries and/or continents.

This study also analysed the success factors of GPI in terms of capabilities. Even though GPI development and conventional new product development have many success factors in common, this study shows that some distinctive capabilities are required for successful GPI development. With regard to capabilities in common with conventional new product development, it would be interesting for future research to investigate whether there is a difference between GPI development and conventional new product development in terms of relative importance of these capabilities and in terms of their extent of use.

Referring to adopted theories, few of the reviewed studies explicitly rely on established organizational and managerial theories. Further, in the analysed studies, some theories have not been used, but could be of great relevance. These are the dynamic capabilities theory and the contingency theory. In particular, the DCs theory could be particularly suitable to study dynamic environments such as that characterizing environmental sustainability (Dangelico, 2010), while contingency theory could be useful to take into account the uncertainties linked to market, regulation and technology characterizing environmental sustainability.

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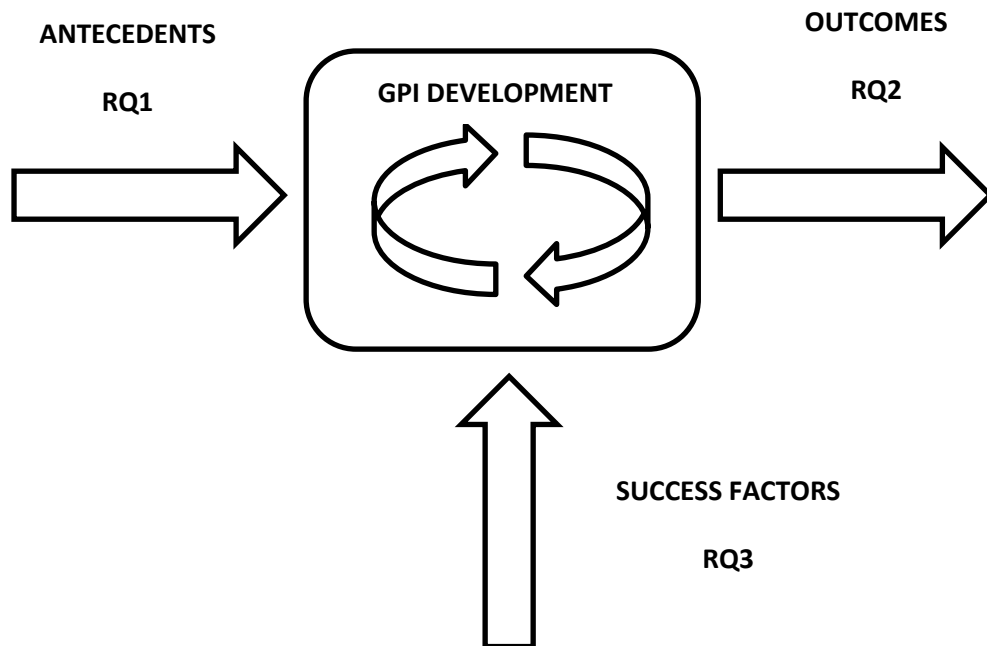
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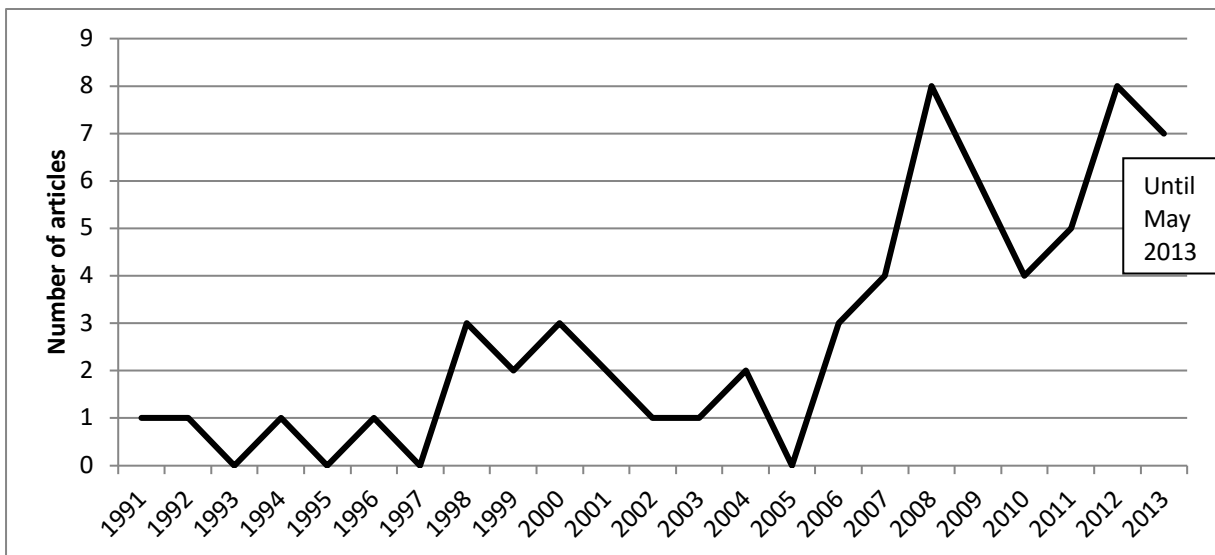
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**FIGURES**



**Figure 1: Theoretical framework of the study. Each arrow represents the positioning of each of the three research questions.**



**Figure 2: Distribution of articles over the years.**



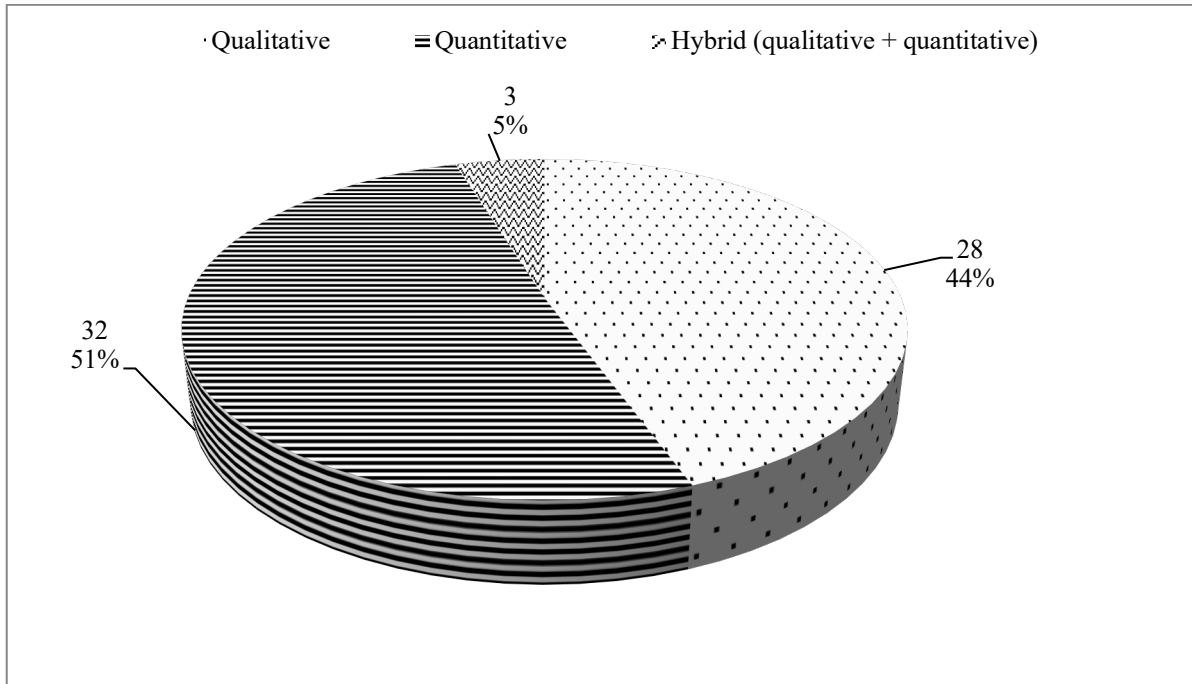


Figure 3: Number and percentage of studies using different types of methodologies.

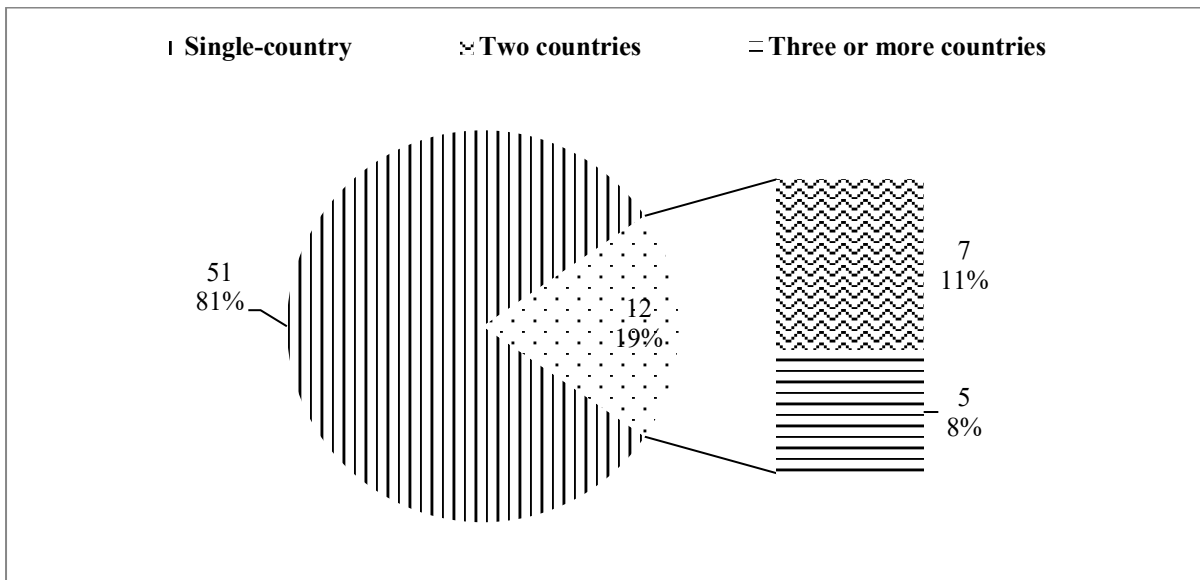
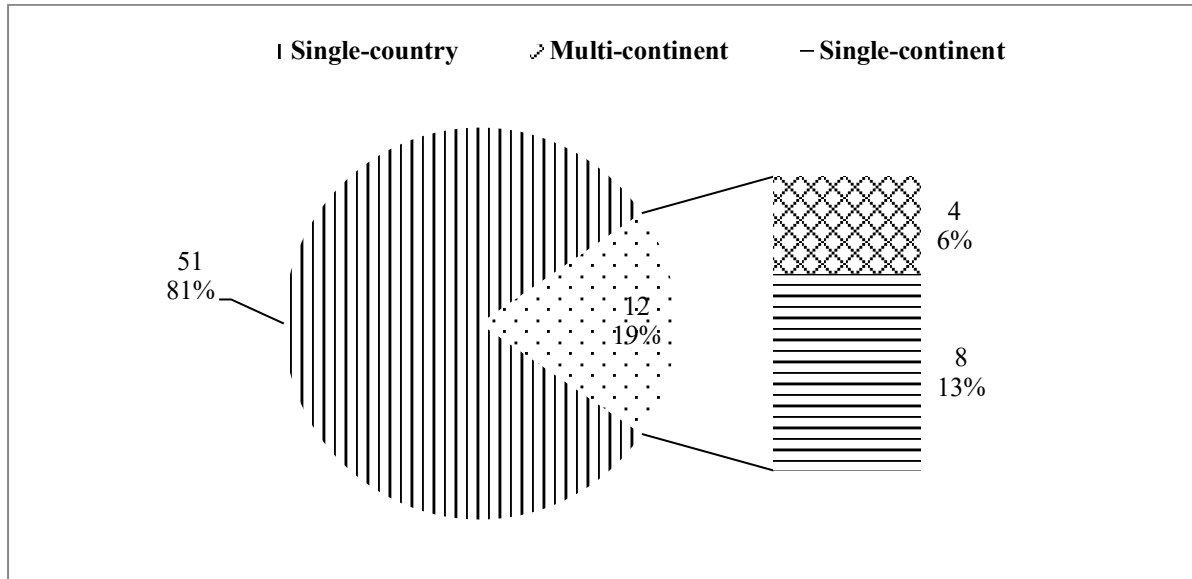
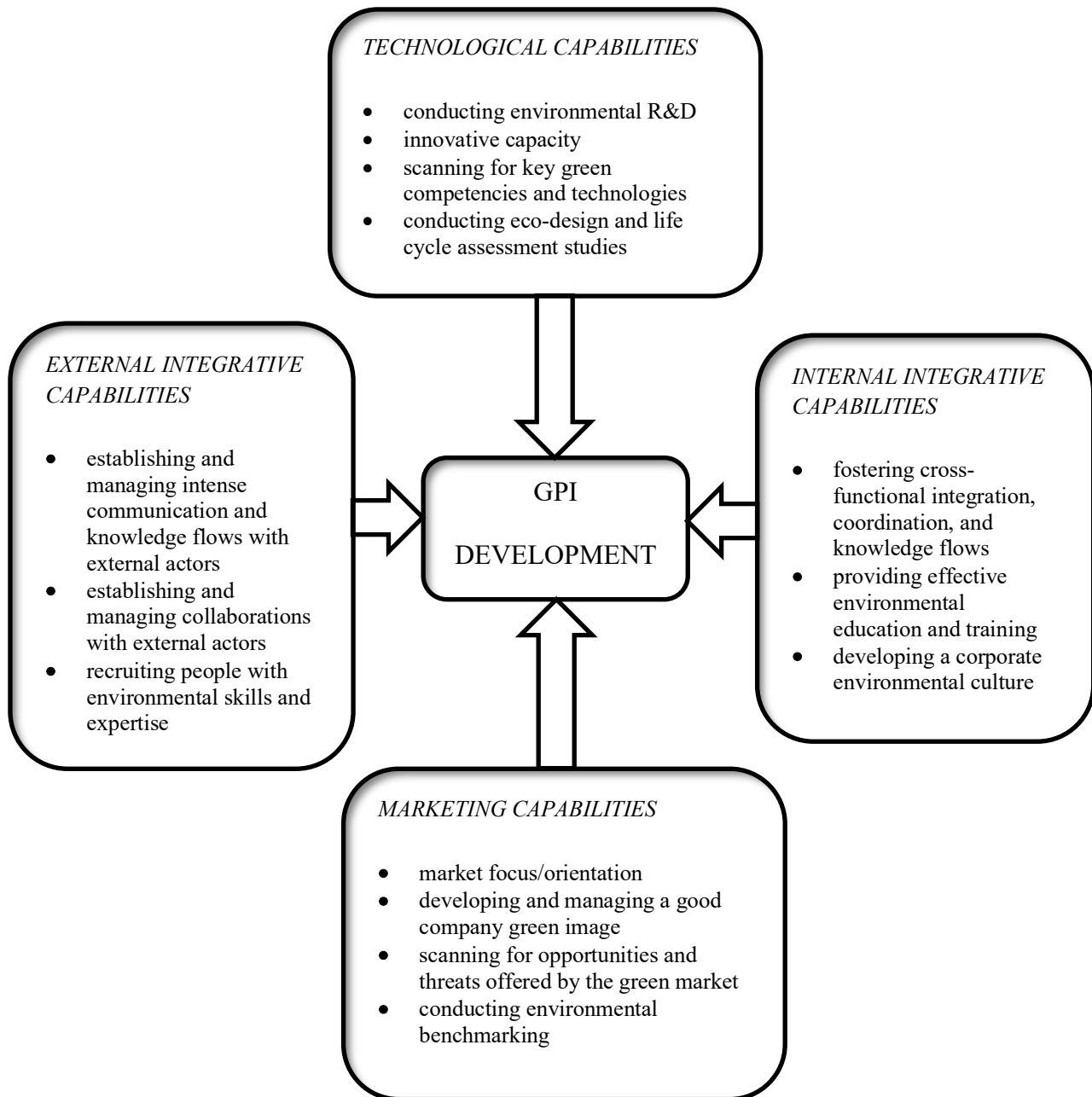


Figure 4: Studies divided into single versus multi-country, which on turn are distinguished into two and three or more countries' studies.



**Figure 5: Studies divided into single versus multi-country, which on turn are distinguished into single-continent and multi-continent studies.**



**Figure 6: A RBV model of GPI development success factors. Adapted from Verona (1999) to the GPI context, based on this study result.**

**TABLES**

**Table 1: Description of searched databases and search options.**

Database	Description	Search options
Ebsco (Business Source Complete)	<i>Business Source Complete</i> is a wide database with content from peer-reviewed, business related journals. Besides full text, it includes indexing and abstracts for the most important scholarly business journals, dating back as far as 1886. Searchable cited references are provided for more than 1,300 journals.	<ul style="list-style-type: none"> <li>• Search in: TI Title; KW-Author supplied keywords; AB Abstract or author-supplied abstract</li> <li>• Limit to: peer reviewed academic publications</li> <li>• Document type: Article - Academic publication peer reviewed</li> <li>• Source type: Academic journal</li> <li>• Data range: all years to May 2013</li> <li>• Language: English</li> </ul>
Scopus	<i>Scopus</i> is the world's largest abstract and citation database of peer-reviewed literature. It contains over 20,500 titles from 5,000 publishers worldwide and 49 million records.	<ul style="list-style-type: none"> <li>• Search in: Article Title, Abstract, Keywords</li> <li>• Document type: Article</li> <li>• Source type: Journal</li> <li>• Subject area: Social science and humanities</li> <li>• Data range: all years to May 2013</li> <li>• Language: English</li> </ul>
Web of Science (WoS)	<i>Web of Science</i> is a research platform to find, analyse, and share information in the sciences, social sciences, arts, and humanities. It uses cited reference search to track prior research and monitor current developments, including 2.6 million records and backfiles since 1898.	<ul style="list-style-type: none"> <li>• Search in: Topic</li> <li>• Document type: Article</li> <li>• Citations databases: all except than "Conference Proceedings"</li> <li>• Data range: all years to May 2013</li> <li>• Language: English</li> </ul>

**Table 2: Keywords and keywords' combinations employed in the literature search and number of results for each database.**

Keywords' combinations	Scopus	Ebsco <sup>3</sup>	WoS	Scopus + Ebsco + WoS
• "green product"	203	89	145	
• "green new product"	6	4	2	

<sup>3</sup> Due to the peculiarities of search options in Ebsco, where there is an AND between two keywords (X AND Y), I searched X in Title AND Y in Abstract + X in Title AND Y in Keywords.

• “sustainable product”	121	69	99	
• “sustainable new product”	2	0	1	
• “environmental product”	73	62	92	
• “environmental new product”	3	4	2	
• “environmentally friendly product”	68	5	19	
• “environmentally friendly new product”	0	0	0	
• “eco friendly product”	23	4	6	
• “eco friendly new product”	0	0	0	
• “eco product”	6	2	6	
• “eco new product”	0	0	0	
• “environmental innovation” & product	45	12	33	
• “eco innovation” & product	33	8	40	
• “green innovation” & product	15	5	16	
• “sustainable innovation” & product	17	9	13	
• “eco friendly innovation” & product	0	0	0	
• “environmentally friendly innovation” & product	1	1	2	
<b>Total</b>	616	274	476	1366

**Table 3: Name of publications where studies included in the review were published, with number of articles.**

<i>Publication name</i>	<i>Number of articles</i>
Business Strategy and the Environment	8
Journal of Cleaner Production	5
Ecological Economics	5
Journal of Business Ethics	4
European Environment	3
International Journal of Innovation and Sustainable Development	3
Research Policy	3
European Journal of Innovation Management	2
IEEE Transactions on Engineering Management	2
Management Decision	2
Other journals (one article per journal)	26
<i>Total</i>	<i>63</i>

**Table 4: Number of studies with a focus on different countries.**

<b>Country</b>	<b>Total number of studies (single + multi country)</b>
Germany	16
UK	11
The Netherlands	10
Taiwan	7
USA	6
Sweden	4
Canada	4
Italy	3
China	3
Belgium	3
Korea	2
Australia	2
France	2
Hungary	2
Norway	2
Switzerland	2
Finland	2
India	1
Japan	1
Austria	1

Brazil	1
Vietnam	1
South Africa	1
New Zealand	1

**Table 5: Number of studies addressing each research question.**

<b>Research question</b>	<b>Number of studies addressing each research question</b>
Antecedents of GPI	38
Outcomes of GPI	18
Success Factors of GPI	33

**Table 6: Number of studies addressing one, two, or three research questions.**

<b>Number of addressed research questions</b>	<b>Number of studies</b>
1	40
2	20
3	3
<b><i>Total</i></b>	<b>63</b>